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THE STATUS OF THE ATLANTIC SALMON STOCK OF FORTEAU RIVER, LABRADOR, 1995

by

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Résumé

Est présentée la deuxième évaluation de la situation du stock de saumon atlantique de la rivière Forteau basée sur les résultats recueillis à la barrière de dénombrement de ce cours d'eau, qui en 1995, a été installée plus en amont. Un relevé de l'habitat a permis d'établir qu'un total de 551 500 m^2 en superficie fluviale et de 896 ha en superficie lacustre étaient adéquats pour la croissance du saumon. D'après ces résultats, on a établi un taux de ponte cible de 1 417 680 oeufs, atteint à 74 % en 1995 par rapport à 46 % en 1994.

La remonte de petits saumons en 1995 était égale à celle de 1994, mais la remonte de gros saumons était de 91 % supérieure à celle de l'année précédente. Par rapport à la moyenne 1987-1991, soit avant la mise en vigueur d'une réduction de l'effort de pêche commerciale au Labrador, la remonte de petits saumons en 1995 et 1994 avait diminué, tandis que la remonte de gros saumons avait augmenté en 1995, mais était demeurée semblable en 1994.

Pour ce qui est de la pêche récréative, les prises retenues de petits saumons en 1995 étaient inférieures aux prises de 1994 et à la moyenne 1987-1991, mais les prises de gros saumons en 1995 étaient les deuxièmes plus élevées depuis 1989. Toutefois, les PUE en 1995 et 1994 étaient les plus faibles depuis 1976.

L'abondance accrue de gros saumons dans la rivière Forteau en 1995 peut être due au retard de quatre semaines de l'ouverture de la pêche commerciale du saumon au Labrador, ce qui aurait résulté en une plus faible mortalité par pêche des gros saumons de la montée hâtive et une remonte plus abondante dans la rivière. La pêche commerciale dans la ZPS 14(B) a récolté 1,6 t du quota de 6,5 t en 1995. Malgré un accroissement du nombre de gros saumons, la tendance générale vers une faible remonte totale n'a pas changé en 1995 et, d'après la faible échappée connue au début des années 90, on ne s'attend pas à une amélioration de la remonte dans les prochaines années. Afin d'assurer la croissance et la stabilité futures de ce stock de saumon, il doit y avoir ponte minimum chaque année.

ABSTRACT

This is the second assessment of the status of the Atlantic salmon stock on the Forteau River based on a counting fence operation. For the 1995 assessment, the counting fence was located further upstream than in the previous year and a habitat survey was completed which indicated that a total of 551,500 m^2 of fluvial area and 896 ha of lacustrine area were available to salmon rearing in the river. Based on the available habitat, the target spawning requirement for the Forteau River is 1,417,680 eggs. Seventy-four percent of this target was achieved in 1995 compared to 46% in 1994.

The return of small salmon to the Forteau River in 1995 was the same as in 1994 but the return of large salmon was 91% above the return in 1994. Compared to the 1987-1991 mean, which was prior to the implementation of effort reductions in the commercial salmon fishery in Labrador, the return of small salmon in 1995 and 1994 decreased, whereas, the return of large increased in 1995 but had remained the same in 1994.

In the recreational fishery, the retained catch of small salmon in 1995 was below the catch in 1994 and below the 1987-1991 mean but the catch of large salmon in 1995 was the second highest since 1989. However, the CPUE in 1995 and 1994 was the lowest since 1976.

The increased abundance of large salmon in the Forteau River in 1995 may have been due to the four week delay in the opening date of the commercial salmon fishery in Labrador which would have resulted in decreased commercial fishing mortality on early run large salmon and increased returns to the river. The SFA 14 (B) commercial fishery landed 1.6t of the 6.5t quota in 1995. In spite of the improvement in large salmon abundance, the current overall trend of low total returns on the Forteau River did not change in 1995 and based on the low spawning escapements experienced in the early 1990s, returns to the river are not expected to improve in the near future. In order to ensure future growth and stability of this salmon stock, the minimum spawning requirements need to be achieved each year.

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INTRODUCTION

The Forteau River is one of the three scheduled salmon rivers in Salmon Fishing Area (SFA) 14(B) (Figure 1). The Forteau River flows into Forteau Bay (Figure 2), in the Strait of Belle Isle at latitude 59° 29' N and longitude 56° 58' W. It has a drainage area of 389 km^2, from a barren plateau with a basin relief of 336 m and has a total axial length (including tributaries) of 198 km (Anderson 1985).

The first assessment of an individual salmon stock in SFA 14(B) was conducted on the Forteau River in 1994 following exceptionally low recreational catches of large salmon in 1989-1992 which suggested a decline in abundance (Figure 3). In spite of incomplete information on the available salmon rearing habitat, the 1994 assessment revealed that the stock was indeed at a low level in comparison what must have been present in the 1960s to produce such high catch rates of small and large salmon. It was not possible to back-calculate returns in previous years from the 1994 results because the presence of the counting fence resulted in an increase in angling exploitation below the fence. To improve the assessment in 1995, the counting fence was operated further upstream than in 1994 to improve fish passage and prevent over-exploitation. As well, a stream survey was carried out to verify earlier estimates of the amount of accessible salmon rearing habitat available in the river.

In 1995, management changes were implemented in both the recreational and commercial salmon fisheries in SFA 14(B). The recreational season bag limit of two large salmon in 1994 was reduced to one in 1995, but the daily bag limit of two and the seasonal bag limit of six salmon remained unchanged. The commercial season opening date of June 6 in 1994 was delayed until July 3 in 1995 and the SFA 14(B) commercial quota was reduced from 8t in 1994 to 6.5t in 1995. These season and bag limit changes were aimed at increasing river escapements, particularly of large salmon.

The Forteau River estuary was closed to spinner fishing inside of Buckle's Point (Figure 2) beginning June 24 in 1995 due to a reported high by-catch mortality of salmon kelts. Repeat spawning one-sea-winter salmon make up the majority of large salmon returns to the Forteau River, unlike the Pinware River where the majority of large salmon are virgin multi-sea-winter fish (Lowe and Mullins, 1994). Therefore, the survival of kelts from the Forteau River is very important to the rebuilding of the stock.

MATERIALS AND METHODS

Fisheries Harvests

Recreational catches of retained and released small (<63 cm fork length) and large salmon (≥ 63 cm fork length) and effort in rod-days were completed on a weekly basis by the Department of Fisheries and Oceans (DFO) River Guardians and Fisheries Officers for the entire angling season in 1995 as in previous years (Lowe and Mullins, 1994) with one exception. In 1995 angling camps were provided with logbooks to record their own catch and effort statistics which were collected on a weekly basis by DFO Fisheries Officers. In previous years, this information had been included in the weekly reports completed by River Guardians.

The angling effort presented in this document for 1976-1995 has been adjusted from previous reports to include only the rod-days recorded after the first salmon was landed (retained or released). The reason for this is that angling effort recorded early in the season is directed towards trout.

Commercial catches of salmon were compiled from purchase slips supplied by fish buyers.

Returns and Spawning Escapements

The total returns of salmon to the Forteau River was the number of small and large salmon enumerated at the counting fence plus the number removed by anglers below the the fence. The spawning escapement was obtained by subtracting the retained catch of small and large salmon above and below the fence from the total returns to the river.

The counting fence (Anderson and MacDonald 1978) consisted of two steel-frame-traps to count upstream and downstream migrating fish and was installed on the Forteau River approximately 350m upstream from the mouth of Ladies Pool (Figure 2). The fence was operated from June 27 until September 7, 1995. The fence location in 1995 provided a better flow of water through the trap than the 1994 location. At peak times a section of the fence was removed and fish were counted as they move upstream past two observers. Before the counting fence was removed, a snorkel survey was conducted on Ladies Pool (directly below the counting fence) and Armies Pool (directly below the 1994 location of the counting fence) (Figure 2) to determine whether or not any salmon were holding up downstream.

The counting fence was checked daily at 0800, 1200, and 1600 hours. All fish species captured were identified, enumerated and released. Salmon were classed as small or large using a 63 cm fluorescent orange stick resting in the bottom of the counting trap. The air and water temperatures (°C) and water level (cm) were recorded at each trap check.

Estimation of Angling Exploitation Rate

The angling exploitation rate (ER) on the Forteau River in 1995 was calculated for small and large salmon based on retained and released catches of small and large salmon above and below the counting fence and the total returns to the river.

$$ER = \frac{\textit{(total \# of salmon retained and released below and above the counting fence)}}{\textit{(\# of salmon counted at the fence)} + \textit{(total \# of salmon retained below the counting fence)}}$$

The exploitation rate derived for 1995 was used to estimated returns to the river prior to 1993. It is assumed that small and large salmon released in 1992-1995 would have been retained in previous years.

Biological characteristics of Atlantic salmon on Forteau River

Biological characteristics of salmon on the Forteau River were obtained from fish landed in the recreational fishery in 1975-1995. These were sampled for fork length to the nearest 0.1 cm, whole weight to the nearest 0.1 kg and sex composition by internal or external examination. Prior to 1990, sex was not recorded as internal or external. Therefore, female characteristics from 1979-1991 may include salmon sexed both internally and externally. Female characteristics from 1993-1995 were from salmon sexed internally only. Scale samples were obtained for age determination from the left side of the salmon in an area above the lateral line and in line from the posterior edge of the dorsal fin to the anterior edge of the anal fin. Approximately 10-15 scales were collected. The river-age, sea-age and evidence of previous spawning were determined according to the method described by Anonymous (1984). Salmon that passed through the counting fence in 1994 and 1995 were not sampled.

Estimation of Conservation Targets

The target egg deposition for conservation of Atlantic salmon stocks on the Forteau River was estimated based on an optimum egg deposition rate of 2.4 eggs/m^2 (Elson 1975) of fluvial parr rearing habitat and 105 eggs/ha of lacustrine area (O'Connell et al. 1991).

Initial surveys of rearing habitat available to salmon in the Forteau River were based on aerial reconnaissance and 1:250,000 scale topographic maps (Anderson 1985). In 1994, additional habitat areas were added based on the lengths of tributaries visible on 1:50,000 scale topographic maps measured using SPAN GIS. Two preliminary targets were derived in 1994 based on estimated width measurements of these tributaries (1m and 3m) (Lowe and Mullins 1994). These preliminary targets were updated in 1995 with actual stream widths derived from a complete stream survey (Scruton et al., 1992) (Appendix 1).

Target eggs were converted to target spawners based on

Estimation of Potential Egg Depositions

The potential egg deposition by spawners was calculated on the basis of observed biological characteristics collected from salmon retained in the recreational fishery (mean whole weight of females, percent females) and mean fecundity of 1,783 eggs/kg of body weight (Chadwick et al. 1986). This fecundity value represents a maximum value because of the potential for egg loss due to atresia (O'Connell et al. 1991). (NOTE: ovary samples were collected in 1994 and 1995 from salmon retained in the recreational fishery which will be used to verify this relative fecundity value for Atlantic salmon on the Forteau River).

RESULTS

Recreational Fishery

The recreational fishing effort on the Forteau River in 1995 was 13.8% below the effort in 1994, but 38.1% above the 1986-1991 mean and 35.9% above the 1984-1989 mean (Table 1). The number of small salmon retained in 1995 was 19.4% below the 1994 catch, 9.5% below the 1986-1991 mean and 4.0% below the 1984-1989 mean. In contrast, the number of large salmon retained in 1995 was 375% above the 1994 catch, 26.7% above the 1986-1991 and 11.7% above the 1984-1989 means. However, there was no difference between the catch of large salmon in 1995 and the 1992-1994 mean. The total number of retained and released small and large salmon angled in 1995 was 7.8% below the total number angled in 1994, 23.9% below 1986-1991 and 29.9% below the 1984-1989 means suggesting that the total number of fish available in the river did not increase in 1995.

The catch-per-unit effort (CPUE) was up slightly (5.5%) in 1995 compared to 1994 on the Forteau River (Table 1) and the CPUE also improved on Pinware River in 1995 compared to 1994 (Table 2). However, CPUE values in 1995 on both of these SFA 14(B) rivers were below all previous long term means (Table 1 & 2) and were the lowest since angling statistics were recorded (Figure 5).

Commercial Fishery

The commercial fishery in SFA 14(B) in 1995 landed only 1.6t of the 6.5t quota.

Returns and Spawning Escapements

A total of 315 small and 136 large salmon were enumerated at the counting fence on Forteau River in 1995. This includes 45 small and 11 large salmon from visual counts at an opening in the counting fence and seven small and four large salmon from a snorkel survey below the counting fence (Table 3). The highest daily count of small salmon was recorded by observers on August 9 and the highest count of large salmon was recorded on July 28 (Table 3, Figure 6). The highest daily counts occurred on days with the highest range of water temperature and lowest range of water level (Figure 7).

The angling catch below the counting fence in 1995 was 146 small and 11 large salmon for a total return to the river of 461 small and 147 large salmon (Table 4). There was essentially no change in the return of small salmon in 1995 compared to 1994 (458) but the return of large salmon in 1995 was 91% above that in 1994 (Table 4). As a result of the increase in large salmon abundance the total returns in 1995 were 13.6% above the 1994 returns.

The total angling catch in 1995 above and below the counting fence was 249 small and 19 large salmon for a spawning escapement of 212 small and 127 large salmon. This represents an increase of 42.5% for small and 75.3% for large compared to the number of spawners in 1994.

Angling Exploitation Rate

Anglers on the Forteau River retained 54% of the small and 13% of the large salmon returns in 1995 (Table 4). This level of exploitation on small salmon was 20% less than in 1994, whereas, the exploitation on large salmon was more than twice that in 1994. The decrease in angling exploitation on small salmon retained in 1995 compared to 1994 may be attributed to the closure of the angling pool (Ladies Pool) located directly below the counting fence in 1995. Angling below the counting fence was 26% of the total returns of small salmon in 1995 compared to 44% in 1994. Overall, 44% of the small and large salmon returns were retained by anglers in 1995 and 50% were either retained or released (Table 4). The angling exploitation rate for retained and released fish was 0.61 for small salmon and 0.16 for large salmon in 1995.

Biological Characteristics

The mean smolt age of salmon on the Forteau River in 1995 was 4.2 years (n=6) for large, and 4.0 years (n=40) for small which was similar to previous years (Table 5). The predominant smolt age was 4 years for both small and large salmon in 1995 as in previous years (Table 5).

The sea age of large salmon on the Forteau River, although sample sizes are small (<30), was primarily of repeat spawning fish (Table 6). This is in contrast to the sea-age of large salmon on the Pinware River which are predominantly virgin multi-sea-winter salmon. As well, 5% of small salmon on the Forteau

River in 1995 were repeat spawners compared to 0% on the Pinware River. This may be attributed in part to the closure of the estuary to fishing in 1995.

The mean fork length of large salmon angled on the Forteau River in 1995 was 72.8 cm (n=6) and the mean whole weight of females was 4.03 kg (n=3) (Table 7). These values were similar to the 1979-1991 means. The mean fork length of small salmon was 54.8 cm (n=41), which was similar to small salmon in 1994. The mean weight of small females in 1995 was 1.53 kg, which was similar to 1994 but slightly below the 1979-1991 mean.

The sex composition of small salmon (internally sexed) sampled in the Forteau River, 1995, was 69.7% (20/30) female (Table 7). This was relatively unchanged from the percentage female in 1994 (66.1%). In contrast, small salmon on the Pinware River are typically only about 36 % female (Table 8). Large salmon on the Forteau River are about 50% female compared to 78% on the Pinware (Tables 7 and 8). As a result, the majority of eggs deposited on the Forteau River come from 1SW salmon both as virgin and repeat spawners and the target spawning requirement will be higher than if there was a greater percentage of virgin MSW salmon. On the Pinware River there is a greater contribution of eggs from large MSW salmon than on the Forteau.

Conservation Targets and Potential Egg Depositions

The stream survey completed in 1995, measured 5,515 units of fluvial and 896 ha of lacustrine rearing habitat available to salmon on the Forteau River. This includes 2,801 fluvial units and 376 ha of lacustrine habitat measured above what was previously thought to be a complete obstruction (#4) on Eastern Brook by Anderson (1985) (Figure 4). Parr were found above this obstruction, at site 2, by electrofishing in 1995 (Figure 4). The area above the obstruction was estimated from 1:50,000 scale topographical maps using SPANS GIS.

The minimum egg deposition requirement for the Forteau River is 1.4 million eggs based on 5,515 fluvial units (one fluvial unit = 100 m^2) and 896 ha lacustrine of available rearing area (Table 9). Based on the 1993-1995 female biological characteristics, and the percent of large and small salmon recorded at the counting fence in 1994-1995, sufficient females required to achieve the target would come from a total spawning escapement of 501 (361 small and 140 large) salmon (Table 9).

The potential egg deposition for small and large salmon achieved on the Forteau River in 1995 was 1.04 million eggs or 74% of the target (Table 10). Based on the current egg requirement, the potential egg deposition in 1994 (Lowe and Mullins, 1994) achieved only 46% of the target.

The estimated total returns, spawning escapements and the percentage of the target egg deposition achieved in 1975-1993 based on the 1995 exploitation rates for small and large salmon **retained and released** are given in Table 11. It is assumed that released fish were angled only once. The female biological characteristics used in calculating the percentage of target egg deposition achieved for each year is stated in Table 11. The percentage of the target achieved in 1995 was above all long term means, but slightly below the 1992-1994 mean. The percentage of the target achieved in 1993 was the highest since 1969 resulting a high mean for the percent target achieved 1992-1994. The percentage of large salmon returns in 1995 increased in comparison to 1994 and the 1987-1991 mean. The exploitation rate for **retained fish only** would have overestimated the 1994 return of small salmon by 25% compared to 17% for the retained and released value. The higher retained and released exploitation rate for large salmon is also probably more appropriate than the retained value because of the occurrence of high-grading for large salmon.

Returns of small salmon to the Forteau River in 1995 were primarily 80% smolt-age 4 years (Table 5). Therefore, they were produced mainly by spawners in 1989. The spawning escapement in 1989 was among the lowest recorded for the river (Table 11; Figure 8), therefore, it is not surprising that returns in 1995 were relatively low. The spawning escapement in 1990 was similar to 1989 (Table 11), therefore, assuming that the smolt-age distribution and smolt-adult survival of small salmon remains similar to previous years, the returns of small salmon in 1996 are not expected to be any higher than in 1995. However, it is expected that returns of large salmon (mainly repeat spawners) will continue to improve if the same management as in 1995 is implemented in the 1996 commercial fishery or the fishery is closed entirely.

DISCUSSION

The delayed opening of the commercial fishery in 1995 appeared to result in increased returns of large salmon to the Forteau River as compared to 1994. This also had a possible positive effect on small salmon because the total return of small did not decline in 1995 compared to 1994, in spite of a 50% lower spawning escapement in 1989 (342) compared to 1988 (620). The closure of the estuary to angling with spinning gear in 1995 would have also had a positive contribution on small and large salmon returns by increasing the survival of kelts returning to the river as consecutive spawners.

The closure of Ladies Pool to angling in 1995 probably contributed to the lower angling exploitation rate observed in 1995 as compared to 1994 and as a result would have increased the spawning escapement. The reduction in the seasonal bag limit of large salmon from two in 1994 to one in 1995 would also have contributed to higher spawning escapements of large fish. However, this is difficult to evaluate because the increase in large salmon returns may also have resulted in more effort being directed towards large salmon.

In spite of the positive effects of the commercial fisheriy management measures implemented in Labrador in recent years such as effort reductions and lower commercial quotas, the returns of small and large salmon to the Forteau River in 1994 and 1995 were among the lowest of estimated returns from 1975-1993. In addition, the lower bag limits implemented in the recreational fishery have not resulted in increased spawning escapements. The target spawning requirement was not achieved in 1994 or 1995. Based on the low spawning escapements experienced on the Forteau River in the early 1990s, the current low stock abundance is not likely to improve in the next five years. The only way to improve this outlook for the long term, is to ensure that the minimum spawning requirements are achieved each year. The prospects for 1996 and beyond can only be improved if fisheries harvests are further reduced in order to increase the spawning escapements of salmon.

The method used to calculate the target spawning requirements for the Forteau River has a number of limitations which are difficult to quantify. The stream survey completed in 1995 may have under-estimated the amount of juvenile rearing habitat available in the Forteau River because habitat varies with water level and the stream survey ended in a tributary when a complete obstruction was encountered. Salmon parr were found above several obstructions in 1995 which had previously been judged, based on helicopter surveys, to be complete obstructions to salmon migration. Habitat preference by juvenile salmon; the atresia of eggs in the ovary; the degree of dispersion of juveniles from the spawning grounds; and the possible interaction of anadromous and landlocked forms are also potential limitations to full utilization and seeding of the available habitat. These limitations are discussed in detail in O'Connell et al. (1991). However, the method used is accepted as a reasonable standard for the evaluation of stock status.

The main limitations on using the angling exploitation rate from 1995 to retrospectively estimate returns to the river is that it does not account for annual variability in angling pressure which would normally occur as a result of changes in run-timing; water levels on the river; and management restrictions.

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Table 1. Recreational catch and effort for Atlantic salmon on the Forteau River, 1960-1995.

	Effort*	Small salmon			Large salmon			Total	
Year	Rod-days	Retained	Released	Total	Retained	Released	Total	Catch	CPUE
1960	244	385	.	385	52	.	52	437	1.79
1961	430	455	.	455	110	.	110	565	1.31
1962	301	401	.	401	63	.	63	464	1.54
1963	327	271	.	271	64	.	64	335	1.02
1964	534	391	.	391	129	.	129	520	0.97
1965	737	336	.	336	84	.	84	420	0.57
1966	1065	466	.	466	137	.	137	603	0.57
1967	937	459	.	459	153	.	153	612	0.65
1968	898	568	.	568	118	.	118	686	0.76
1969	873	525	.	525	83	.	83	608	0.70
1970	1351	629	.	629	13	.	13	642	0.48
1971	703	342	.	342	24	.	24	366	0.52
1972	886	178	.	178	5	.	5	183	0.21
1973	1151	472	.	472	20	.	20	492	0.43
1974	785	258	.	258	14	.	14	272	0.35
1975	748	284	.	284	7	.	7	291	0.39
1976	1061	818	.	818	19	.	19	837	0.79
1977	1367	612	.	612	32	.	32	644	0.47
1978	821	164	.	164	19	.	19	183	0.22
1979	996	394	.	394	27	.	27	421	0.42
1980	768	339	.	339	31	.	31	370	0.48
1981	1159	540	.	540	23	.	23	563	0.49
1982	1229	557	.	557	14	.	14	571	0.46
1983	1529	748	.	748	14	.	14	762	0.50
1984	1041	402	.	402	18	.	18	420	0.40
1985	846	317	.	317	7	.	7	324	0.38
1986	1282	356	.	356	27	.	27	383	0.30
1987	1180	537	.	537	21	.	21	558	0.47
1988	1414	538	.	538	24	.	24	562	0.40
1989	1225	355	.	355	6	.	6	361	0.29
1990	977	324	.	324	7	.	7	331	0.34
1991	797	205	.	205	3	.	3	208	0.26
1992	1221	219	23	242	9	0	9	251	0.21
1993	1511	385	78	463	43	4	47	510	0.34
1994	1836	309	18	327	4	0	4	331	0.18
1995	1583	249	32	281	19	5	24	305	0.19
MEANS, 95% CONFIDENCE LIMITS AND N'S PRECEDING 1992:									
Mean(84-89)	1165	418	0	418	17	0	17	435	0.38
95%CL=+/-	957	316	0	316	8	0	8	328	0.30
N	6	6	6	6	6	6	6	6	6
Mean(86-91)	1146	386	0	386	15	0	15	401	0.34
95%CL=+/-	912	249	0	249	4	0	4	256	0.26
N	6	6	6	6	6	6	6	6	6
Mean(92-94)	1523	304	40	344	19	1	20	364	0.24
95%CL=+/-	758	98	43	67	34	4	38	35	0.03
N	3	3	3	3	3	3	3	3	3

* Recreational effort, 1976-1995, includes only rod-days recorded from the date on which the first salmon was caught.

Table 2. Recreational catch and effort for Atlantic salmon on the Pinware River, 1964-1995.

	Effort*	Small salmon			Large salmon			Total	
Year	Rod-days	Retained	Released	Total	Retained	Released	Total	Catch	CPUE
1964	672	443	.	443	206	.	206	649	0.97
1965	859	465	.	465	307	.	307	772	0.90
1966	1274	871	.	871	207	.	207	1078	0.85
1967	964	662	.	662	241	.	241	903	0.94
1968	1335	1077	.	1077	238	.	238	1315	0.99
1969	1154	740	.	740	190	.	190	930	0.81
1970	1207	937	.	937	308	.	308	1245	1.03
1971	1556	585	.	585	223	.	223	808	0.52
1972	1471	245	.	245	75	.	75	320	0.22
1973	1738	957	.	957	412	.	412	1369	0.79
1974	1928	482	.	482	277	.	277	759	0.39
1975	1432	785	.	785	147	.	147	932	0.65
1976	2284	1680	.	1680	291	.	291	1971	0.86
1977	2338	1050	.	1050	561	.	561	1611	0.69
1978	1394	409	.	409	164	.	164	573	0.41
1979	1105	507	.	507	92	.	92	599	0.54
1980	1677	599	.	599	306	.	306	905	0.54
1981	2194	1158	.	1158	197	.	197	1355	0.62
1982	1961	714	.	714	66	.	66	780	0.40
1983	1929	1252	.	1252	116	.	116	1368	0.71
1984	2441	585	.	585	167	.	167	752	0.31
1985	1932	661	.	661	88	.	88	749	0.39
1986	2229	680	.	680	156	.	156	836	0.38
1987	2666	1148	.	1148	193	.	193	1341	0.50
1988	2780	824	.	824	225	.	225	1049	0.38
1989	2344	682	.	682	46	.	46	728	0.31
1990	2758	654	.	654	91	.	91	745	0.27
1991	1753	829	.	829	45	.	45	874	0.50
1992	2746	628	38	666	229	0	229	875	0.32
1993	3016	654	336	990	199	26	225	853	0.28
1994	2613	373	68	441	97	10	107	470	0.18
1995	3329	556	195	751	190	76	266	756	0.23
MEANS, 95% CONFIDENCE LIMITS AND N'S PRECEDING 1992:									
Mean(84-89)	2399	763	0	763	146	0	146	909	0.38
95%CL=+/-	2077	550	0	550	76	0	76	654	0.30
N	6	6	6	6	6	6	6	6	6
Mean(86-91)	2422	803	0	803	126	0	126	929	0.39
95%CL=+/-	2004	608	0	608	46	0	46	685	0.29
N	6	6	6	6	6	6	6	6	6
Mean(92-94)	2792	552	147	699	175	12	187	733	0.26
95%CL=+/-	2282	166	260	13	3	21	15	167	0.08
N	3	3	3	3	3	3	3	3	3

* Recreational effort, 1976-1995, includes only rod-days recorded from the date on which the first salmon was caught.

Table 3. The daily counts of Atlantic salmon and trout and mean daily water level, water and air temperatures at the counting fence on the Forteau River, 1995.

Date	Atlantic salmon Small	Atlantic salmon Large	Brook Trout	Sea Trout	Water Level (cm)	Water Temp (C)	Air Temp (C)
27-Jun	0	0	0	0	45.5	.	10.0
28-Jun	0	0	0	0	41.8	.	41.8
29-Jun	0	0	3	0	39.5	.	11.0
30-Jun	0	0	0	0	35.8	.	9.0
01-Jul	0	0	0	0	33.0	.	6.0
02-Jul	0	3	0	0	33.0	.	9.0
03-Jul	2	1	0	0	33.5	.	10.0
04-Jul	1	0	2	0	31.5	11.8	13.0
05-Jul	0	0	3	0	31.0	13.3	16.6
06-Jul	1	1	0	0	29.2	13.8	15.4
07-Jul	0	2	1	0	30.7	13.1	15.0
08-Jul	0	0	0	0	30.0	12.8	13.0
09-Jul	3	1	0	0	30.5	13.6	15.0
10-Jul	2	2	1	0	33.0	14.1	14.4
11-Jul	1	2	0	0	37.8	13.7	15.0
12-Jul	5	0	0	0	42.4	14.6	19.8
13-Jul	4	2	0	0	45.0	15.0	14.8
14-Jul	4	8	1	0	56.6	15.1	17.3
15-Jul	2	7	0	0	64.8	15.2	15.8
16-Jul	1	6	1	0	71.7	14.3	13.3
17-Jul	1	0	0	0	68.3	13.0	12.8
18-Jul	3	5	2	0	62.1	13.7	15.3
19-Jul	6	6	1	0	56.6	13.9	13.9
20-Jul	4	7	4	0	53.4	14.2	16.1
21-Jul	4	5	0	0	49.8	14.9	17.1
22-Jul	6	8	1	0	46.7	15.3	16.9
23-Jul	4	2	1	0	43.7	15.6	18.7
24-Jul	7	2	2	0	40.7	15.3	17.8
25-Jul	11	2	7	0	37.8	16.0	18.6
26-Jul	4	2	8	0	34.6	16.6	17.1
27-Jul	8	4	3	0	33.1	16.2	15.2
28-Jul	12	11	23	0	31.5	16.2	19.3
29-Jul	7	0	1	0	29.8	16.5	16.7
30-Jul	7	1	3	0	30.3	16.5	16.9
31-Jul	13	6	3	0	37.9	16.0	15.5
01-Aug	9	0	2	0	37.0	16.3	18.3
02-Aug*	29	4	1	0	35.3	16.8	17.7
03-Aug	12	3	6	0	32.9	17.2	20.3
04-Aug	3	0	1	0	30.5	17.1	17.0
05-Aug	2	1	1	0	29.0	16.8	14.0
06-Aug	6	0	0	0	27.9	16.7	17.4
07-Aug	7	0	0	1	26.9	16.9	15.5
08-Aug	8	1	2	0	25.7	17.8	19.9
09-Aug*	46	7	4	4	24.1	18.3	24.7
10-Aug	0	4	3	0	22.3	17.5	18.3
11-Aug	4	6	0	2	20.3	18.3	22.8
12-Aug	3	0	1	0	18.5	17.7	18.4
13-Aug	3	0	3	0	19.8	16.6	12.6
14-Aug	1	0	1	0	20.5	15.1	14.0

(continue on next page)

* Visual counts made at an opening in the counting fence.

Table 3. (continued)

Date	Atlantic salmon Small	Atlantic salmon Large	Brook Trout	Sea Trout	Water Level (cm)	Water Temp (C)	Air Temp (C)
15-Aug	1	0	0	1	21.1	15.4	14.2
16-Aug	5	0	0	3	23.9	15.5	16.3
17-Aug	12	0	3	2	29.5	15.8	18.0
18-Aug	3	0	0	1	32.4	15.3	14.8
19-Aug	9	2	0	2	32.5	15.7	22.4
20-Aug	1	1	0	1	30.8	15.8	17.5
21-Aug	0	0	0	0	30.3	16.2	17.0
22-Aug	12	3	0	4	29.2	16.3	18.4
23-Aug	4	1	0	6	31.0	14.9	11.7
24-Aug	0	1	1	0	30.0	15.1	15.0
25-Aug	0	0	0	0	29.0	14.0	9.0
26-Aug	1	2	0	5	31.7	12.3	11.0
27-Aug	3	0	0	0	31.0	12.3	10.2
28-Aug	0	0	0	0	31.5	12.9	12.3
29-Aug	0	0	0	0	31.5	13.1	15.7
30-Aug	0	0	0	0	31.0	13.7	16.3
31-Aug	0	0	0	0	30.3	14.1	20.7
01-Sep	0	0	0	0	29.0	13.2	13.7
02-Sep	0	0	0	0	28.7	13.3	14.7
03-Sep	0	0	0	0	27.3	13.6	18.0
04-Sep	0	0	0	0	26.0	14.1	17.0
05-Sep	0	0	0	3	26.8	14.2	13.7
06-Sep	1	0	0	0	28.5	13.5	12.0
07-Sep**	7	4	0	1	39.0	12.7	9.0
Total	315	136	100	36			

** Snorkel survey counts on Ladies Pool and Armies Pool prior to removal of the counting fence.

Table 4. Total returns, angling catches and angling exploitation rate on small and large salmon on the Forteau River in 1994 and 1995.

				Angling Catch								Exploitation Rate	
	Total Returns to:		Other Known	Above fence		Below fence		Total	Total	Total Retained &	Spawning		Retained &
Year	Fence	River	Removals	Retained	Released	Retained	Released	Retained	Released	Released	Escapement	Retained	Released
Small salmon													
1994	228	458	0	79	4	230	14	309	18	327	149	0.6747	0.7140
1995	315	461	0	103	0	146	32	249	32	281	212	0.5401	0.6095
Large salmon													
1994	74	77	0	1	0	3	0	4	0	4	73	0.0519	0.0519
1995	136	147	1	8	2	11	3	19	5	24	127	0.1293	0.1633
Total													
1994	302	535	0	80	4	233	14	313	18	331	222	0.5850	0.6187
1995	451	608	1	111	2	157	35	268	37	305	339	0.4408	0.5016

Dates of counting fence operation:
1994 25 June to 3 October
1995 27 June to 2 September

Table 5. Smolt age distribution of small and large Atlantic salmon on the Forteau River, 1979-1995. Sampling was from the recreational fishery.

		Smolt Age %					Mean
Year	N	2	3	4	5	6	Smolt age
Large salmon							
1979	2			100.0			4.0
1980	10		20.0	80.0			3.8
1981	7	14.3	28.6	42.9	14.3		3.6
1982	3			100.0			4.0
1990	1			100.0			4.0
1993	6			83.3	16.7		4.2
1994	3			66.7	33.3		4.3
1995	6			83.3	16.7		4.2
Mean(79-93)		14.3	24.3	84.4	15.5	0	3.9
Mean(79-94)		14.3	24.3	81.8	21.4	0	3.9
Small salmon							
1979	56		10.7	75.0	14.3		4.0
1980	68		2.9	69.1	25.0	2.9	4.3
1981	174		17.2	63.8	18.4	0.6	4.0
1982	56		12.5	76.8	8.9	1.8	4.0
1989	11		9.1	72.7	18.2		4.1
1990	31		9.7	61.3	25.8	3.2	4.2
1993	59		11.9	84.7	3.4		3.9
1994	109		10.1	76.4	12.8		4.0
1995	40		7.5	80.0	12.5		4.0
Mean(79-93)		0	10.6	83.9	16.3	2.1	3.7
Mean(79-94)		0.0	10.5	72.5	15.9	2.1	4.1

Table 6. Sea age distribution of small and large Atlantic salmon on Forteau River and Pinware River, 1974-1995. "CS" refers to consecutive year spawners and "AS" refers to alternate year spawners.

			Small salmon			Large salmon					
River	Year	Total No. Aged	N	% 1SW	% CS 1SW	N	% MSW	% CS 1SW	% AS 1SW	% CS MSW	% AS MSW
Forteau River	1975	66	66	100.0	0.0	0					
	1979	58	56	100.0	0.0	2	0.0	50.0	50.0	0.0	0.0
	1980	78	68	100.0	0.0	10	100.0	0.0	0.0	0.0	0.0
	1981	181	175	100.0	0.0	6	33.3	0.0	16.7	50.0	0.0
	1982	56	55	98.2	1.8	1	100.0	0.0	0.0	0.0	0.0
	1989	38	38	97.4	2.6	0					
	1990	35	33	100.0	0.0	2	0.0	100.0	0.0	0.0	0.0
	1993	65	59	100.0	0.0	6	66.7	16.7	0.0	0.0	16.7
	1994	114	111	98.2	1.8	3	0.0	100.0	0.0	0.0	0.0
	1995	46	41	95.1	4.9	6	33.3	16.7	50.0	0.0	0.0
	Total	737	702	98.9	1.1	36	41.7	35.4	14.6	6.3	2.1
Pinware River	1974	189	122	100.0	0.0	67	100.0	0.0	0.0	0.0	0.0
	1980	136	100	100.0	0.0	36	91.7	0.0	2.8	0.0	5.6
	1981	480	386	99.7	0.3	93	94.6	2.2	2.2	1.1	0.0
	1982	290	262	100.0	0.0	28	82.1	3.6	10.7	0.0	3.6
	1985	30	26	100.0	0.0	4	100.0	0.0	0.0	0.0	0.0
	1988	14	3	100.0	0.0	11	90.9	0.0	9.1	0.0	0.0
	1990	17	15	93.3	6.7	2	100.0	0.0	0.0	0.0	0.0
	1991	7	4	100.0	0.0	3	100.0	0.0	0.0	0.0	0.0
	1992	3	1	100.0	0.0	2	100.0	0.0	0.0	0.0	0.0
	1993	47	37	100.0	0.0	10	80.0	0.0	20.0	0.0	0.0
	1994	39	29	100.0	0.0	9	88.9	0.0	0.0	11.1	0.0
	1995	137	114	100.0	0.0	23	100.0	0.0	0.0	0.0	0.0
	Total	1389	1099	99.4	0.6	288	94.0	0.5	3.7	1.0	1.1

Table 7. Biological characteristics of small and large virgin and repeat spawning Atlantic salmon on the Fortuna River, 1975-1995.

	FORK LENGTH (cm)					FORK LENGTH FEMALES (cm)					WHOLE WEIGHT (kg)					WHOLE WEIGHT FEMALES (kg)					NO	FEMALE	
Year	N	MEA	MIN	MA	STD	N	MEA	MIN	MA	STD	N	MEA	MIN	MA	STD	N	MEA	MIN	MAX	STD	SE	N	%
Large salmon																							
79	2	75.0	75.0	75.0	0.00	0					2	4.10	4.10	4.10	0.00	0					2	0	
80	10	72.9	67.0	78.0	3.80	7	72.6	67.0	78.0	4.20	10	4.07	3.00	4.50	0.49	7	3.99	3.00	4.50	0.56	10	7	70.0
81	7	69.9	63.0	79.5	7.20	2	71.0	68.0	74.0	4.20	7	3.80	3.00	4.80	0.63	2	4.65	4.50	4.80	0.21	7	2	28.6
90	3	70.0	65.0	78.0	7.00	1	67.0	67.0	67.0		3	3.37	2.20	5.00	1.46	1	2.90	2.90	2.90		3	1	33.3
91	1	69.2	69.2	69.2		1	69.2	69.2	69.2		1	3.00	3.00	3.00		1	3.00	3.00	3.00		1	1	100.0
93	6	72.5	63.0	77.0	5.50	3	76.7	76.0	77.0	0.60	6	3.68	2.30	4.70	0.86	3	4.27	3.70	4.70	0.51	5	3	60.0
94	3	68.7	63.0	79.0	9.00	2	71.5	64.0	79.0	10.60	1	1.86	1.86	1.86		1	1.86	1.86	1.86		2	2	100.0
95	6	72.8	65.0	81.0	6.60	3	74.7	65.0	81.0	8.50	5	3.66	2.00	5.24	1.34	3	4.03	2.55	5.24	1.37	3	3	100.0
Mean (79-91)	25	73.1	63.0	97.0	7.40	11	71.5	67.0	78.0	4.00	25	4.21	2.20	10.00	1.55	11	3.90	2.60	4.70	0.80	25	11	44.0
Mean (93-95)*	15	71.9	63.0	81.0	6.35	8	74.6	64.0	81.0	6.40	12	3.52	1.86	5.24	1.12	7	3.80	1.90	5.20	1.20	10	8	80.0
Small salmon																							
75	0					0					0					0					69	60	87.0
79	59	54.2	51.0	60.0	2.00	25	53.9	51.0	56.0	1.80	58	1.76	1.40	2.20	0.18	25	1.76	1.40	2.10	0.16	59	25	42.4
80	68	55.0	47.0	62.0	3.10	52	54.6	47.0	62.0	3.30	68	1.89	1.00	2.80	0.40	52	1.87	1.00	2.80	0.40	68	52	76.5
81	174	54.3	43.0	62.0	2.90	103	54.0	43.0	62.0	2.80	174	1.89	1.00	2.80	0.35	103	1.83	1.00	2.80	0.33	173	103	59.5
82	56	53.3	47.0	59.0	2.60	31	53.0	47.0	58.0	2.40	56	1.72	1.00	3.30	0.36	31	1.71	1.00	3.30	0.39	55	31	56.4
89	13	55.0	51.0	58.0	2.20	8	54.2	51.0	58.0	2.30	14	1.70	1.00	2.10	0.29	8	1.65	1.40	2.00	0.19	11	8	72.7
90	34	56.2	52.0	60.0	2.10	18	56.8	55.0	60.0	1.20	34	1.70	1.30	2.10	0.18	19	1.73	1.50	2.10	0.18	33	19	57.6
91	11	55.1	47.0	59.7	3.70	7	54.7	47.0	59.7	4.20	11	1.61	1.00	2.00	0.30	7	1.56	1.00	2.00	0.33	7	7	100.0
93	60	55.4	51.0	61.5	2.80	35	54.7	51.0	61.5	2.60	57	1.68	1.00	2.50	0.32	34	1.67	1.00	2.30	0.31	56	35	62.5
94	110	55.1	47.5	61.0	2.70	39	54.8	47.5	60.5	2.60	46	1.44	0.94	2.00	0.25	31	1.46	0.94	2.00	0.26	59	39	66.1
95	41	54.8	48.0	61.0	3.05	19	54.0	48.0	58.0	2.60	41	1.64	1.10	2.24	0.29	19	1.50	1.10	1.90	0.20	30	19	63.3
Mean (79-91)	423	54.4	43.0	62.0	2.82	247	54.2	43.0	62.0	2.80	422	1.82	1.00	4.30	0.35	248	1.80	1.00	3.20	0.30	484	308	63.6
Mean (93-95)*	211	55.1	47.5	61.0	2.81	93	54.6	47.5	61.5	2.60	144	1.59	0.94	2.50	0.31	84	1.60	0.90	2.30	0.30	145	93	64.1

*Note: Sex composition based on internally sexed salmon only.

Table 8. Biological characteristics of small and large virgin and repeat spawners Atlantic salmon of the Pinware River, 1974-1995.

	FORK LENGTH (cm)					FORK LENGTH FEMALES (cm)					WHOLE WEIGHT (kg)					WHOLE WEIGHT FEMALES (kg)					NO.	FEMALE	
Year	N	MEA	MIN	MA	STD	N	MEA	MIN	MA	STD	N	MEA	MIN	MA	STD	N	MEA	MIN	MA	STD	SE	N	%
Large salmon																							
80	33	73.9	63.0	94.0	5.60	24	73.6	64.0	81.0	4.40	33	4.67	2.20	8.50	1.11	24	4.71	3.50	6.80	0.87	29	24	82.8
81	92	75.4	63.0	86.0	3.60	70	75.3	63.0	82.0	3.50	92	4.67	3.00	7.00	0.70	70	4.68	3.00	7.00	0.73	90	70	77.8
82	29	73.5	68.0	87.5	3.80	20	73.6	69.0	87.5	4.20	29	4.36	3.00	7.90	0.92	20	4.51	3.10	7.90	0.99	26	20	76.9
85	4	67.4	63.0	71.0	3.30	4	67.4	63.0	71.0	3.30	4	3.30	2.90	3.50	0.27	4	3.30	2.90	3.50	0.27	4	4	100.0
88	11	80.2	76.2	85.1	2.80	10	79.8	76.2	83.8	2.40	11	5.20	4.10	5.90	0.51	10	5.13	4.10	5.70	0.48	11	10	90.9
90	2	77.2	72.9	81.5	6.10	2	77.2	72.9	81.5	6.10	2	5.15	4.00	6.30	1.63	2	5.15	4.00	6.30	1.63	2	2	100.0
91	3	76.0	72.0	78.0	3.50	2	75.0	72.0	78.0	4.20	3	4.67	4.00	5.30	0.65	2	4.65	4.00	5.30	0.92	2	2	100.0
92	2	76.5	76.0	77.0	0.70	1	77.0	77.0	77.0		2	4.30	4.30	4.30	0.00	1	4.30	4.30	4.30		2	1	50.0
93	11	77.5	63.0	86.0	6.20	6	73.9	63.0	79.5	5.70	9	4.83	2.30	6.50	1.23	4	4.28	2.30	5.70	1.42	11	6	54.5
94	6	78.7	69.9	86.0	6.30	0					0					0					0	0	
95	22	76.3	70.2	86.0	3.60	6	76.4	72.4	81.3	3.70	13	5.02	4.30	7.03	0.71	1	5.45	5.45	5.45	0.00	10	6	60.0
Mean (80-93)	187	75.1	63.0	94.0		139	74.9	63.0	87.5	4.30	185	4.63	2.20	8.50	0.87	137	4.64	2.30	7.90	0.84	177	139	78.5
Mean (80-94)	193	75.2	63.0	94.0	4.70	139	74.9	63.0	87.5	4.30	185	4.63	2.20	8.50	0.87	137	4.64	2.30	7.90	0.84	177	139	78.5
Small salmon																							
74	0					0					0					0					187	67	35.8
80	99	54.7	40.0	62.0	4.00	34	54.2	40.0	62.0	4.00	103	2.02	1.00	8.00	0.83	34	1.93	1.20	4.10	0.55	71	34	47.9
81	388	52.6	43.0	61.0	2.60	133	52.7	44.0	61.0	2.90	388	1.77	1.00	3.00	0.32	133	1.77	1.00	3.00	0.38	376	133	35.4
82	261	53.6	37.5	62.0	3.50	70	53.6	47.5	59.4	2.60	260	1.70	1.20	2.80	0.25	70	1.65	1.20	2.40	0.21	203	70	34.5
85	26	53.9	50.0	57.5	2.50	5	55.2	50.0	57.5	3.10	25	1.66	1.10	2.30	0.26	5	1.90	1.40	2.30	0.32	26	5	19.2
88	3	53.1	52.7	53.3	0.30	1	53.3	53.3	53.3		3	1.50	1.40	1.60	0.10	1	1.50	1.50	1.50		2	1	50.0
89	15	54.8	45.0	60.0	3.20	4	54.5	52.0	55.5	1.60	0					0					14	4	28.6
90	15	56.2	49.9	60.4	2.50	9	56.0	49.9	58.5	2.70	14	1.98	1.50	2.40	0.20	9	1.98	1.50	2.40	0.24	15	9	60.0
91	4	54.5	53.0	58.0	2.40	2	56.0	54.0	58.0	2.80	4	1.85	1.70	2.20	0.24	2	1.95	1.70	2.20	0.35	4	2	50.0
92	2	55.0	54.0	56.0	1.40	0					2	1.85	1.70	2.00	0.21	0					2	0	
93	36	55.0	47.7	60.0	2.80	12	54.3	47.7	59.5	3.50	35	1.71	1.00	2.30	0.28	11	1.65	1.00	2.20	0.35	33	12	36.4
94	35	55.0	48.5	59.0	2.50	1	57.0	57.0	57.0		8	1.95	1.50	2.40	0.30	1	2.10	2.10	2.10		2	1	50.0
95	116	54.8	49.0	61.5	2.90	15	54.5	50.0	60.0	2.90	77	1.79	1.25	2.61	0.31	10	1.76	1.41	2.61	0.39	34	15	44.1
Mean (74-93)	849	53.4	37.5	62.0		270	53.4	40.0	62.0		834	1.78	1.00	8.00		265	1.76	1.00	4.10		933	337	36.1
Mean (74-94)	884	53.5	37.5	62.0	3.20	271	53.4	40.0	62.0	3.10	842	1.78	1.00	8.00	0.41	266	1.76	1.00	4.10	0.37	935	338	36.1

Table 9. Estimation of Atlantic salmon egg deposition and spawner requirements for the Forteau River.

Estimation of Target Egg Deposition Requirement:

Rearing Units - (100 sq. m)	5,515	(this document)
Lacustrine Area (ha)	896	(this document)

Minimum Egg Deposition Requirement:

240 eggs per Fluvial Rearing Unit (Elson, 1975)
105 eggs per ha of Lacustrine Area (O'Connell et al., 1991)

= (5515 x 240) + (896 x 105)
= 1,417,680

Biological Characteristics, 1993-1995:

Fecundity		1,783 eggs / kg	(Chadwick et al.,1986)
Small -	% overall	72.1 (n=753)	(counting fence, 1994-95)
	% female	64.1 (n=145)	(recreational, 1993-95)
	mean wt. females	1.6 kg(n=84)	(recreational, 1993-95)
Large -	% overall	27.9 (n=753)	(counting fence, 1994-95)
	% female	80.0 (n=10)	(recreational, 1993-95)
	mean wt. females	3.8 kg(n=7)	(recreational, 1993-95)

Estimation of Eggs per Spawner:

Small = (% small * % female * mean wt. * fecundity)
= (.721 * .641 * 1.6 * 1783)
= 1318

Large = (%large * % female * mean wt. * fecundity)
= (.279 * .80 * 3.8 * 1783)
= 1512

Estimation of Target Spawners for Sufficient Females:

= egg requirements / eggs per spawner

$$= \frac{1{,}417{,}680}{2831} = 501 \text{ (small and large)}$$

	total	females	males
Small	361	231	130
Large	140	112	28
Totals	501	343	158

Estimation of target Spawners for Sufficient Males:

Table 10. Estimation of percentage of egg deposition target achieved on the Forteau River, 1995.

Biological Characteristics, 1995:

Fecundity		1783 eggs / kg	(Chadwick et al. 1986)
Small -	% overall	69.8 (n=451)	(counting fence, 1995)
	% female	63.3 (n=30)	(recreational, 1995)
	mean wt. female	1.5 kg (n=20)	(recreational, 1995)
Large -	% overall	30.2 (n=451)	(counting fence, 1995)
	% female	80.0 (n=10)	(recreational, 1993-95)
	mean wt. female	3.8 kg (n=7)	(recreational, 1993-95)

Estimation of Percent of Target Eggs Achieved, 1995:

= potential egg depositions / target egg deposition requirement x 100

$$= \frac{(\text{small spawners} * \%\text{female} * \text{mean wt} * \text{fecundity}) + (\text{large spawners} * \%\text{female} * \text{mean wt} * \text{fecundity})}{(\text{Rearing Units} * \text{Optimum Egg Depositions}) + (\text{Lacustrine Area} * \text{Optimum Egg Depositions})}$$

$$= \frac{(212 * .633 * 1.5 * 1,783) + (127 * .80 * 3.8 * 1,783)}{(5515 * 240) + (896 * 105)} \times 100$$

$$= \frac{1047288}{1417680} \times 100$$

Percent of Target Eggs Achieved: 74%

Table 11. Atlantic salmon assessment results for 1994 and 1995 and retrospective analysis for 1975-1993.

Target: 1.4 x 10^6 eggs (361 small and 140 large salmon)

	Angling Catch													%
	Retained & Released Retained						Estimated Returns*			Spawning Escapem			%	Target
Year	Small	Large	Total	Small	Large	Total	Small	Large	Total	Small	Large	Total	Large	met
1960	385	52	437	385	52	437	632	318	950	247	266	513	33.5	93
1961	455	110	565	455	110	565	747	674	1420	292	564	855	47.4	164
1962	401	63	464	401	63	464	658	386	1044	257	323	580	37.0	107
1963	271	64	335	271	64	335	445	392	837	174	328	502	46.8	96
1964	391	129	520	391	129	520	642	790	1431	251	661	911	55.2	179
1965	336	84	420	336	84	420	551	514	1066	215	430	646	48.3	124
1966	466	137	603	466	137	603	765	839	1604	299	702	1001	52.3	194
1967	459	153	612	459	153	612	753	937	1690	294	784	1078	55.4	212
1968	568	118	686	568	118	686	932	723	1655	364	605	969	43.7	183
1969	525	83	608	525	83	608	861	508	1370	336	425	762	37.1	140
1970	629	13	642	629	13	642	1032	80	1112	403	67	470	7.2	72
1971	342	24	366	342	24	366	561	147	708	219	123	342	20.8	58
1972	178	5	183	178	5	183	292	31	323	114	26	140	9.5	22
1973	472	20	492	472	20	492	774	122	897	302	102	405	13.7	66
1974	258	14	272	258	14	272	423	86	509	165	72	237	16.8	39
1975	284	7	291	284	7	291	466	43	509	182	36	218	8.4	34
1976	818	19	837	818	19	837	1342	116	1458	524	97	621	8.0	96
1977	612	32	644	612	32	644	1004	196	1200	392	164	556	16.3	92
1978	164	19	183	164	19	183	269	116	385	105	97	202	30.2	36
1979	394	27	421	394	27	421	646	165	812	252	138	391	20.4	54
1980	339	31	370	339	31	370	556	190	746	217	159	376	25.4	95
1981	540	23	563	540	23	563	886	141	1027	346	118	464	13.7	73
1982	557	14	571	557	14	571	914	86	1000	357	72	429	8.6	59
1983	748	14	762	748	14	762	1227	86	1313	479	72	551	6.5	84
1984	402	18	420	402	18	420	660	110	770	258	92	350	14.3	57
1985	317	7	324	317	7	324	520	43	563	203	36	239	7.6	37
1986	356	27	383	356	27	383	584	165	749	228	138	366	22.1	63
1987	537	21	558	537	21	558	881	129	1010	344	108	452	12.7	73
1988	538	24	562	538	24	562	883	147	1030	345	123	468	14.3	76
1989	355	6	361	355	6	361	582	37	619	227	31	258	5.9	41
1990	324	7	331	324	7	331	532	43	574	208	36	243	7.5	34
1991	205	3	208	205	3	208	336	18	355	131	15	147	5.2	20
1992	242	9	251	219	9	228	397	55	452	178	46	224	12.2	40
1993	463	47	510	385	43	428	760	288	1047	375	245	619	27.5	143
1994	327	4	331	309	4	313	458	77	535	149	73	222	14.4	46
1995	281	24	305	249	19	268	461	147	608	212	127	339	24.2	74
Means:														
(1975-83)	495	21	516	495	21	516	812	127	939	317	106	423	15.3	69
(1984-89)	418	17	435	418	17	435	685	105	790	267	88	355	12.8	58
(1987-91)	392	12	404	392	12	404	643	75	718	251	63	314	9.1	49
(1992-94)	344	20	364	304	19	323	538	140	678	234	121	355	18.0	76

* Total returns from 1960-1993 based on 1995 angling exploitation rate of 0.6095 for small salmon and 0.1633 for large salmon.
Salmon released in 1992-1995 would have been kept in previous years.

**Biological characteristics : 1960-1978 and 1984-1988 % large met based on mean female characteristics for 1979-1991.
: Large salmon 1992-1993 based on mean female characteristics 1993-1995 (internal sex only)
: Large salmon 1979, 1981-1982 based on female characteristics for 1979-1991.
: Small salmon 1979, 1981-1982 based on female characteristics for each year.
: Small salmon 1993-1995 based on female characteristics for each year; 1992 based on 1993-1995 mean characteristics. Internal sex only.
: 1991 - % female based on 1979-1991 mean for small salmon
: % target met for 1980 based on female characteristics for small and large salmon from salmon sampled in 1980

Legend:
1) Forteau River
2) L'anse au Loup River
3) Pinware River

Figure 1. Location of scheduled salmon rivers in Salmon Fishing Area 14(B), southern Labrador.

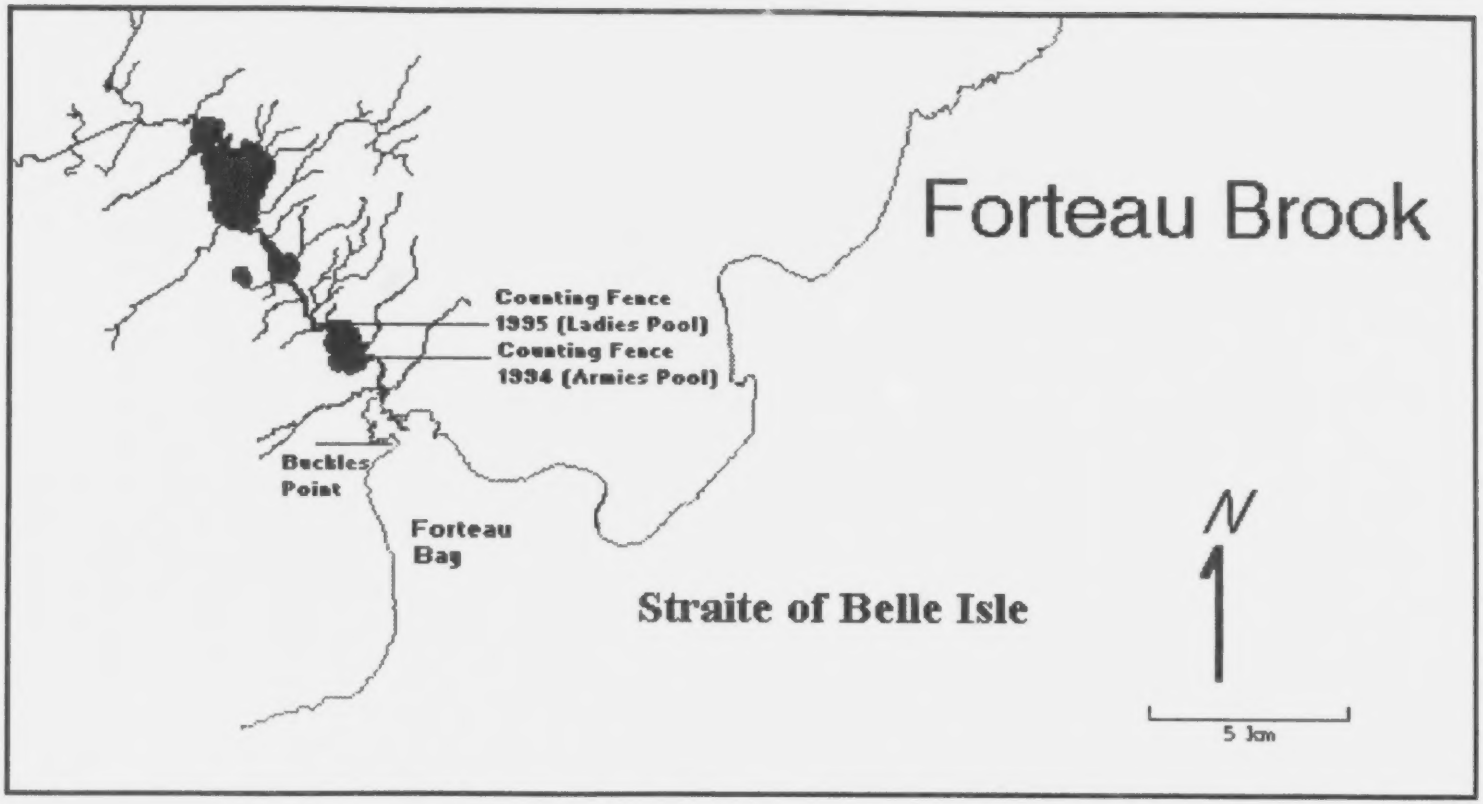

Figure 2. Map of Forteau River from mouth to Inside Pond showing counting fence locations.

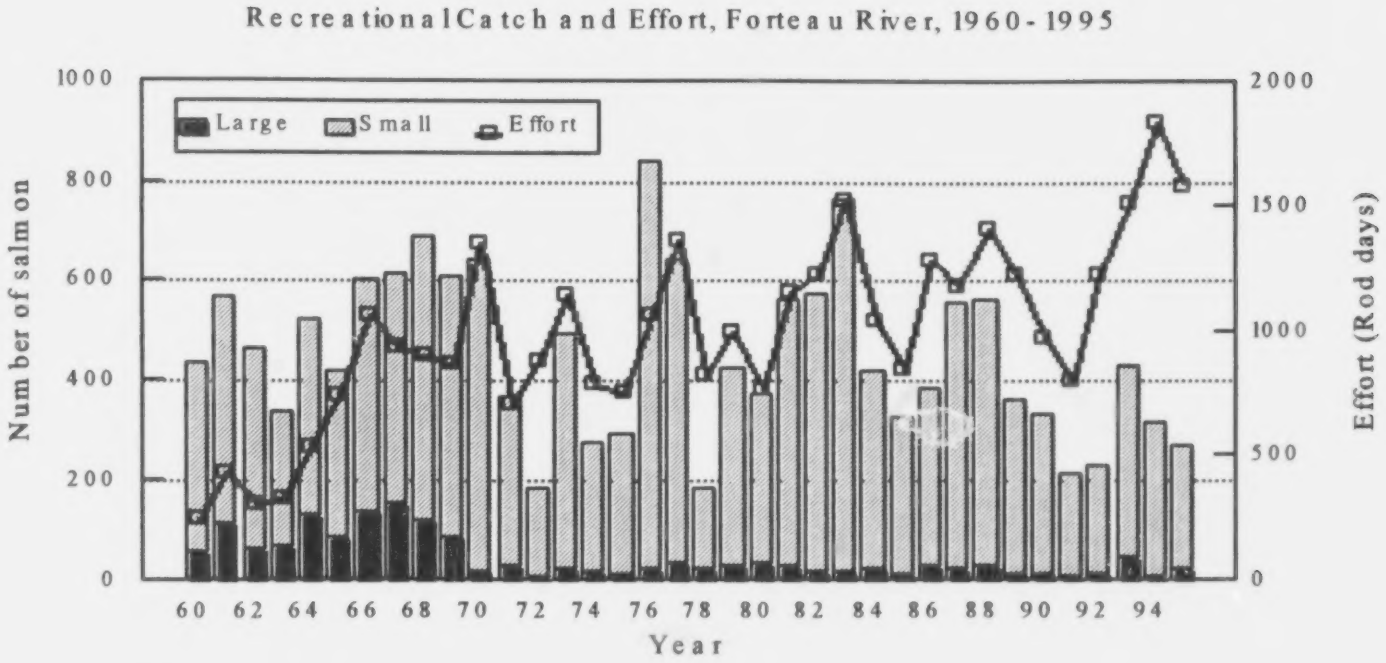

Figure 3. Recreational catch and effort of Atlantic salmon on the Forteau River, 1960-1995.

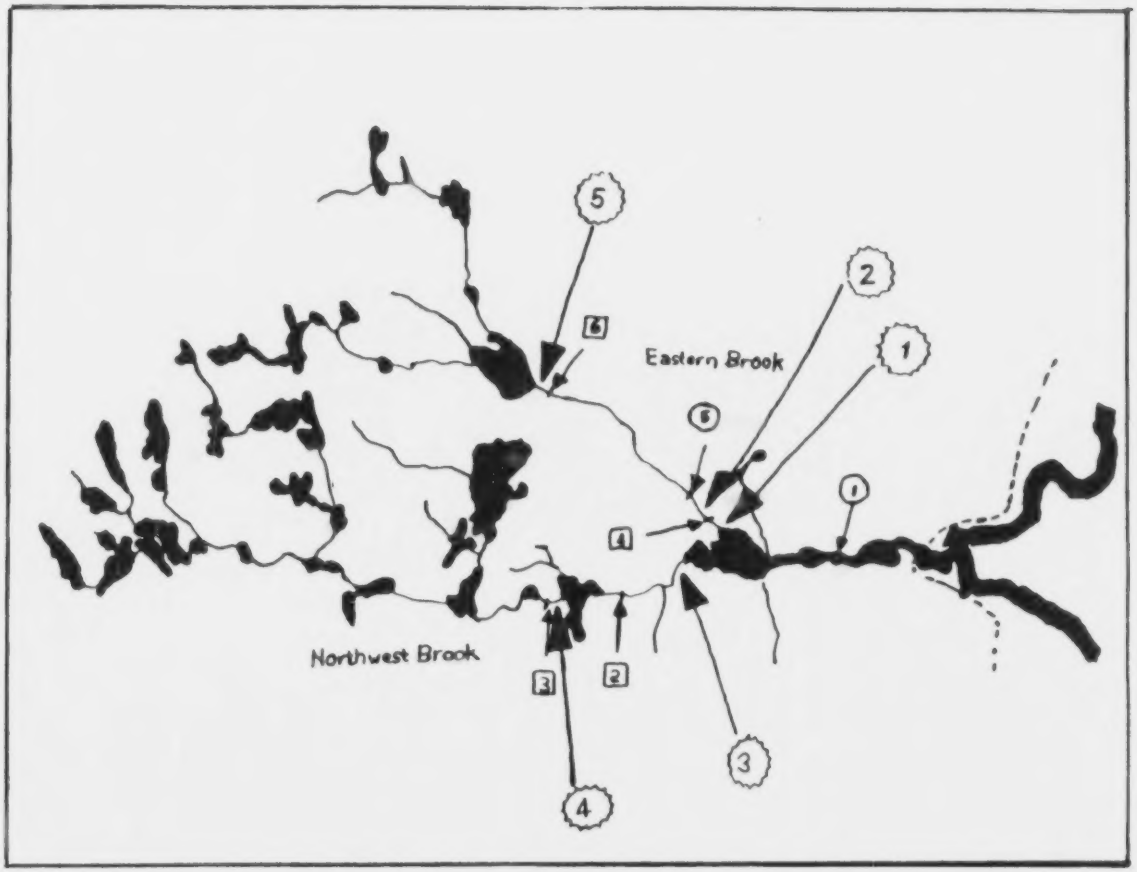

Figure 4. Locations of partial and complete obstructions described by Anderson (1985) and locations of 1995 juvenile survey sites, on the Forteau River. Circles indicate the location of partial obstructions; squares indicate location of complete obstructions; serrated circles indicate locations of 1995 juvenile survey sites (8 August site 1, 14 September sites 2 and 3, and 19 October sites 4 and 5).

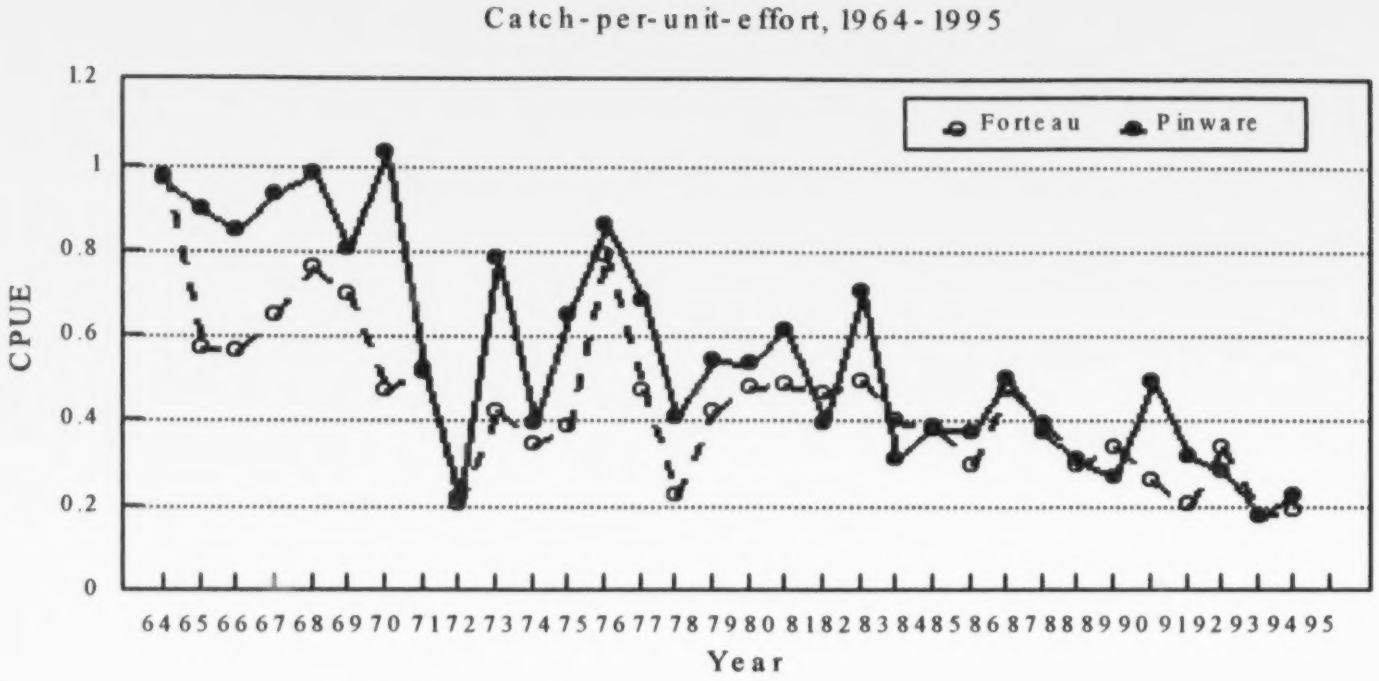

Figure 5. Catch-per-unit-effort (CPUE) for Atlantic salmon on Forteau River and Pinware River, 1964-1995.

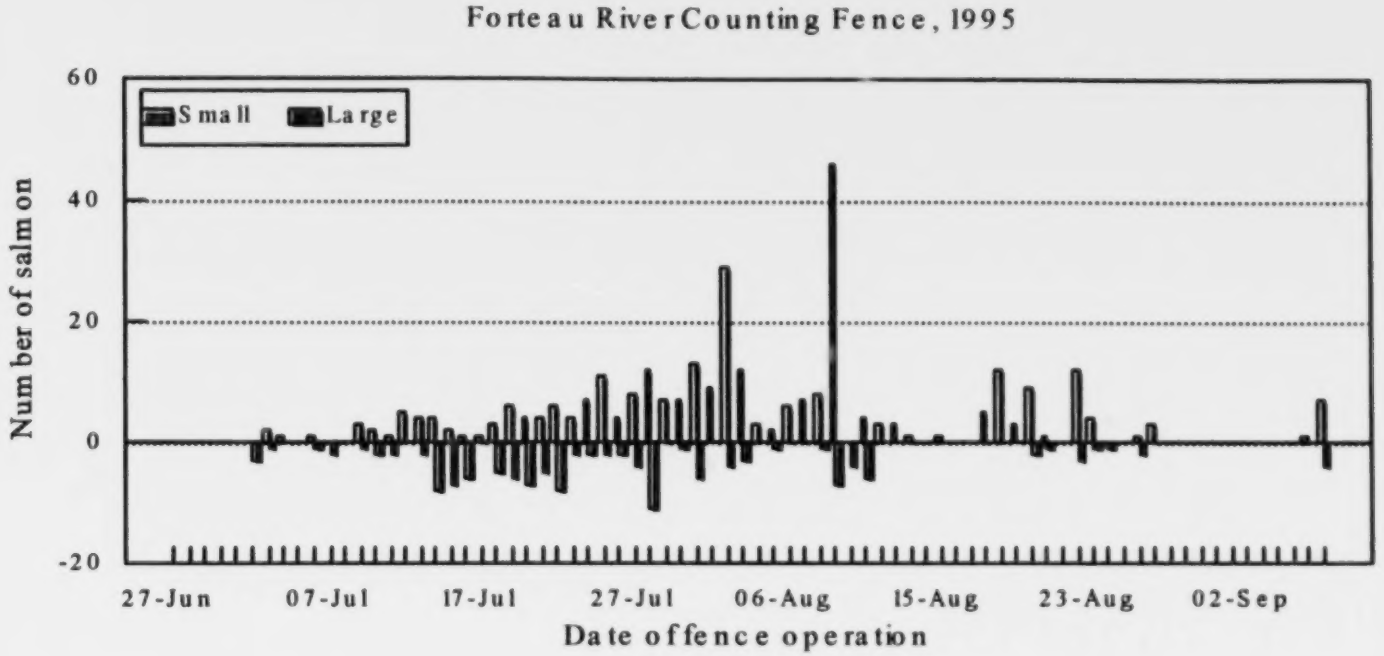

Figure 6. Daily counts of small and large Atlantic salmonat the Forteau River counting fence, 1995.

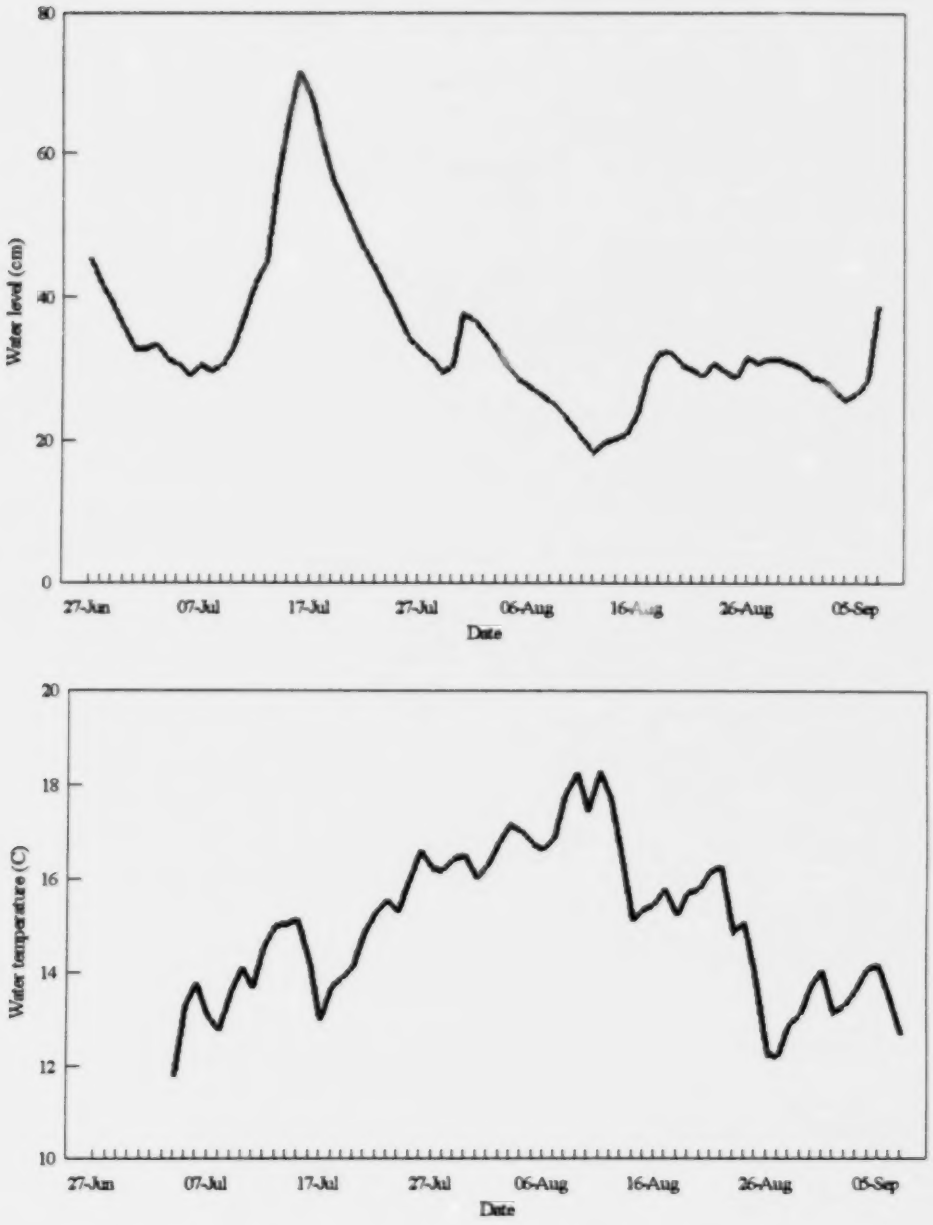

Figure 7. The water level (cm) and water temperature (C), recorded at the counting fence on the Forteau River, 1995

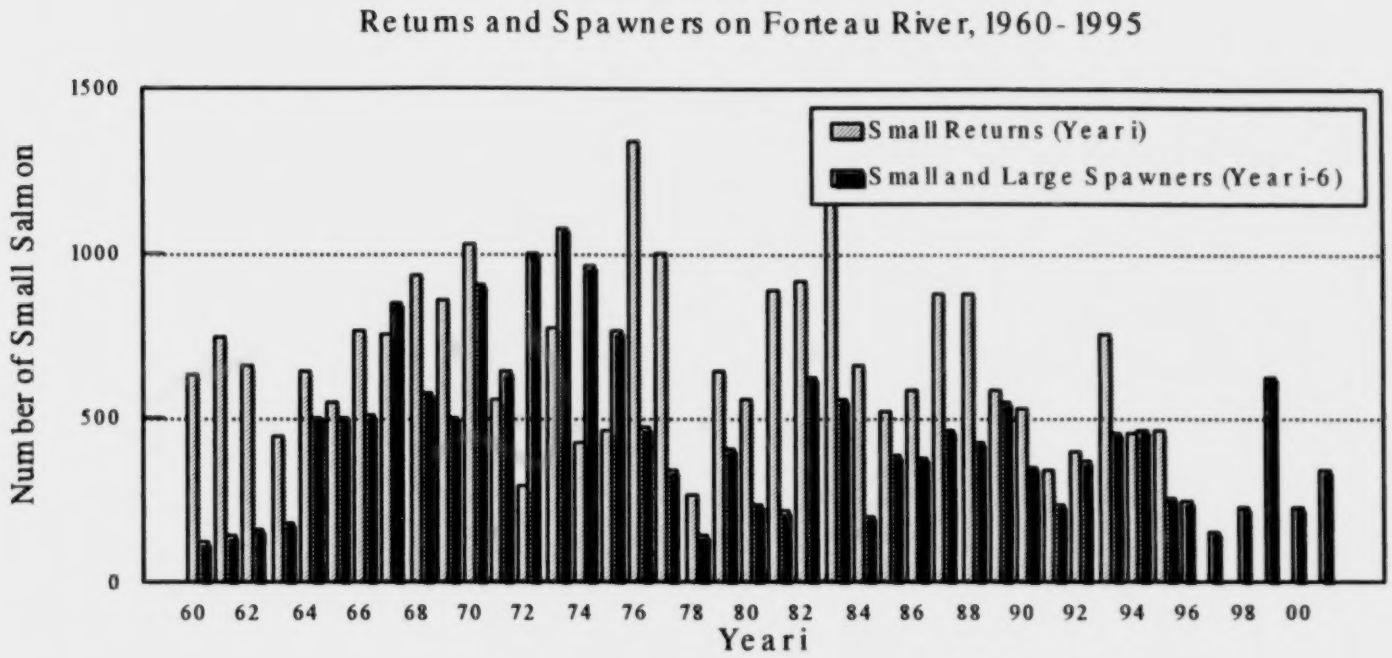
Returns and Spawners on Forteau River, 1960-1995
Small Returns (Year i)
Small and Large Spawners (Year i-6)
Number of Small Salmon
1500
1000
500
0
60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 00
Year i

Figure 8. Estimated return of small salmon in year i and estimated spawners (small and large) in year i-6.

Appendix 1. Summary of bottom area (m2) and rearing units (100m2) measured in the stream survey on the Forteau River, 1995.
Includes tributaries flowing into the mainstem and the three ponds.

River Sections	Total section Length (m)	Total Bottom Area (m2)	% Classical Rearing area	Total rearing units (100m2)
Tributaries flowing into:				
Main stem	4,352	309,651	70.3	2,178
First Pond	1,405	14,936	47.2	71
Middle Pond	378	996	51.2	5
Inside Pond	4,533	57,251	80.4	460
Above Obstruction #4 on Eastern Brook:				
	53,766	351,558	79.7	2,801
Total	64,434	734,391	75.1	5,515